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ABSTRACTS

Lilia Anguelova *(INRNE & Bulgarian Academy of Sciences, Sofia)*

Hidden Symmetries and Exact Solutions in Two-field α-attractor Models

The increasing and impressive precision of cosmological observations nowadays makes it imperative to achieve better theoretical understanding of cosmological inflation. The conventional description is in terms of a single scalar field, whose potential energy drives the accelerated expansion in the Early Universe. However, there are a number of reasons to consider alternative models, either with many scalars and/or with non-standard ("non-slow-roll") inflationary regimes. I will discuss a class of two-scalar field models, known as α-attractors. More precisely, I will describe the conditions for such models to have Noether symmetry and the implications of that symmetry for the form of their scalar potential. I will also show some exact solutions of the equations of motion of these models.

Viviana del Barco *(CONICET - Universidad Nacional de Rosario)*

Symmetric Killing tensors on Riemannian 2-step nilpotent Lie groups

A symmetric Killing tensor in a Riemannian manifold is a symmetric tensor such that the symmetrized part of its covariant derivative vanishes. This concept generalizes that of Killing vector fields on Riemannian manifolds. These tensors define first integrals of the equation of motion and, as such, define constant functions along the geodesics. Parallel symmetric tensors, symmetric products of Killing vector fields and linear combinations of those give examples of symmetric Killing tensors on the manifold. These tensors are called “decomposable” and any symmetric tensor which is not of this form is called “indecomposable”. In general, it is not easy to determine whether a Riemannian manifold admits indecomposable symmetric Killing tensors. In this talk, I will discuss recent results on the existence of indecomposable left-invariant symmetric Killing 2-tensors on 2-step nilpotent Lie groups endowed with a left-invariant Riemannian metric. It will be shown that for 2-step nilpotent Lie groups of dimension less than or equal to 7, every symmetric Killing tensor is decomposable. Instead, for every dimension greater than 7, there are Lie groups admitting indecomposable symmetric Killing 2-tensors. The present talk is based on joint work with Andrei Moroianu.

Stefan Berceanu *(IFIN-HH, Bucharest)*

Invariant metrics on homogeneous manifolds attached to the Jacobi group

The real Jacobi group $\mathbf{G^J_n(\mathbb{R})}$, defined as the semidirect product of the Heisenberg group with the symplectic group of appropriate dimension, is an intersting object in Mathematics, with many applications in Physics. $\mathbf{G^J_n(\mathbb{R})}$ is embedded in $\mathbf{Sp(n+1,\mathbb{R})}$. The Siegel-Jacobi space $\mathbf{X}^{\mathbf{J}}{}_n \approx \mathbf{X_n} \times \mathbb{R}^{2n}$, where $\mathbf{X_n}$ is the Siegel upper half-plane, admits a balanced metric. The invariant metric on the extended Siegel-Jacobi space $\mathbf{\tilde{X}}^{\mathbf{J}}{}_n \approx \mathbf{X}^{\mathbf{J}}_{\mathbf{n}} \times \mathbb{R}$ is obtained. The formulae are very simple in the case of $\mathbf{G^J_1(\mathbb{R})}$, where the invariant metrics are obtained as sum of squares of invariant one-forms.

Gaetan Borot *(Max Planck Institut for Mathematics, Bonn)*
Introduction to geometric recursion
I will describe the basics of the theory of geometric recursion. It is designed to produce, for instance, functions on the moduli space of the Teichmuller space that are mapping class group invariant, and whose integration on the moduli space satisfy a recursion on the Euler characteristic (called topological recursion and dating back to Chekhov, Eynard and Orantin). I will show how to set it up using two different metric geometries, hyperbolic and combinatorial, explain the relation between these two settings, and give applications (old and new) to compute certain volumes (Weil-Petersson, Kontsevich, Masur-Veech) of various moduli spaces. This is based on joint works with Andersen, Orantin, Charbonnier, Delecroix, Giacchetto, Lewanski, Wheeler.

Vasile Brinzanescu *(IMAR, Bucharest)*
Moduli of vector bundles as integrable Hamiltonian systems
We shall describe moduli spaces of stable rank-2 vector bundles non non-Kaehler elliptic surfaces as algebraically complete integrable Hamiltonian systems analogously to Hitchin systems.

Stefan Carstea *(Department of Physics, IFIN-HH, Bucharest)*
Lattice super-KdV equation - integrability, reductions and singularities
Starting from the complete integrable lattice super-KdV equation, we discuss Lax and bilinear integrability. Also two super-mappings are obtained by performing a travelling-wave reduction. The first one is linear and the second is a four dimensional super-QRT mapping containing both Grassmann commuting and anti-commuting dependent variables. Adapting the classical "staircase" method to the Lax super-matrices of the lattice super-KdV equation, we compute the Lax super-matrices of the mapping and the two invariants; the first one is a pure nilpotent commuting quantity and the second one is given by an elliptic curve containing nilpotent commuting Grassmann coefficients as well. In the case of finitely generated Grassmann algebra with two generators, the super-QRT mapping becomes a four-dimensional ordinary discrete dynamical system that has two invariants but does not satisfy singularity confinement criterion. However it can be analysed by resolution of singularities on the 4D projective space. The action of the lifted mapping on the Picard group allows computation of the two invariants.

Martin Cederwall *(Department of Physics, Chalmers University of Technology, Göteborg)*
Extended geometry and tensor hierarchy algebras
The recent investigation of the gauge structure of extended geometry is generalised to situations when ancillary transformations appear in the commutator of two generalised diffeomorphisms. The relevant underlying algebraic structure turns out to be a tensor hierarchy algebra rather than a Borcherds superalgebra. This tensor hierarchy algebra is a non-contragredient superalgebra, generically infinite-dimensional, which is a double extension of the structure algebra of the extended geometry. We use it to perform a (partial) analysis of the gauge structure in terms of an $\mathbf{L}_\infty$ algebra for extended geometries based on finite-dimensional structure groups. An invariant pseudo-action is also given in these cases. We comment on the continuation to infinite-dimensional structure groups.

Eugen Mihaita Cioroianu *(Department of Physics, University of Craiova)*
Twisted Jacobi versus Jacobi with background structures
Relaxing the twisted Jacobi structures by giving up the closedness condition, we introduce the concept of Jacobi structure with background. The new structures: i) display integrable characteristic distributions and ii) are in one-to-one correspondence with `homogeneous' Poisson structures with 3-form background.

Vicente Cortés *(Department of Mathematics, University of Hamburg),*
Quaternionic Kähler manifolds with large groups of isometries
I will present two constructions of complete quaternionic Kähler manifolds of negative scalar curvature with large isometry groups. Both methods yield, in particular, many non locally homogeneous examples. Also examples with nontrivial fundamental group can be constructed in this way. The main part of the talk is based on joint work with Dyckmanns, Jüngling and Lindemann, see arXiv:1701.7882, another part on joint work in progress with Saha and Thung.

Marija Dimitrijević Ćirić *(Department of Physics, University of Belgrade)*
Nonassociative differential geometry and gravity
In the context of string theory, it is expected that closed string sector provides a framework for a quantum theory of gravity. Namely, the massless bosonic modes of the closed string sector contain gravitational degrees of freedom such as the metric, the B-field, and the dilaton. In particular, in locally non-geometric backgrounds one expects to find a low-energy limit of closed string theory which is described by an effective nonassociative theory of gravity on spacetime. Attempts to formulate a consistent effective gravity theory in the space-time, starting from the nonasocaitive phase space of closed strings were done in [1, 2, 3]. There the construction is done using the twist approach. The twist approach provides a well defined way to introduce the noncommutative/ nonassocaitive differential geometry and the notions of connections and curvature. The essential step [2, 3] is the projection from the phase space to the spacetime via the zero momentum leaf. This talk is based on [2, 3]. In the talk we will explain how the metric aspects of nonassociative differential geometry tailored to the parabolic phase space model of constant locally non-geometric closed string vacua are developed. We will use the nonassociative differential geometry to construct preliminary steps towards a nonassociative theory of gravity on spacetime. Explicit expressions for the torsion, curvature, Ricci tensor and Levi-Civita connection in nonassociative Riemannian geometry on phase space are obtained in this way. Using the projection to the zero momentum leaf, we construct the R-flux corrections to the Ricci tensor on spacetime, and comment on the potential implications of these structures in non-geometric string theory and double field theory.
References:
[1]. R. Blumenhagen and M. Fuchs, *Towards a theory of nonassociative gravity*, JHEP 1607 (2016) 019, [arXiv:1604.03253].
[2]. P. Aschieri and R. Szabo, *Triproducts, nonassociative star products and geometry of R-flux string compactifications*, J.Phys.Conf.Ser. 634 (2015) no.1, 012004, [arXiv:1504.03915].
[3]. P. Aschieri, M. Dimitrijević Ćirić and R. Szabo, *Nonassociative differential geometry and gravity with non-geometric fluxes*, JHEP 1802 (2018) 036, [arXiv:1710.11467].

Olivia Dumitrescu *(Central Michigan University)*
Stratifications and conformal limits
There have been developments in understanding Lagrangian stratifications of the de Rham moduli space in connection and the Dolbeault moduli space through biholomorphic isomorphisms of the Lagrangian fibers. I will report recent results by different groups of authors.

Dan-Radu Grigore *(Department of Physics, IFIN-HH, Bucharest)*
Perturbative Quantum Field Theory: the causal approach
We give an outline of the framework of perturbative QFT (or renormalization theory) in the causal approach.

Nicolina Istrati *(Tel Aviv University)*

On a class of Kato manifolds

This talk concerns Kato manifolds, also known as manifolds containing a global spherical shell. I will recall Brunella's proof of the fact that Kato surfaces admit locally conformally Kähler metrics and show that it holds in any complex dimension. Then I will describe a specific class of these manifolds, defined in terms of some matrices. I will discuss some of their analytical properties, showing in particular how to obtain new examples of non-exact locally conformally Kähler manifolds of positive algebraic dimension and admitting non-trivial holomorphic vector fields. These results are joint work with Alexandra Otmnan.

Nikola Konjik *(Faculty of Physics, University of Belgrade)*

Noncommutative Scalar Quasinormal Modes of RN Black Hole

In this talk a noncommutative deformation of scalar field theory is introduced by an angular twist. The angular twist is an Abelian twist, defined by two commuting vector fields: the generator of the time translations and the generator of rotations around the z-axis. Noncommutative scalar field in curved space is discussed. In particular, the dynamics of a noncommutative charged scalar field in the Reissner-Nordstrom black hole background is analyzed. Solving the scalar field equation of motion with appropriate boundary conditions, the quasinormal mode spectrum is obtained. Noncommutativity induces a splitting of spectral lines with respect to the magnetic quantum number **m**. Different methods are used to calculate the quasinormal mode spectrum: WKB method, continued fraction method and an analytic method. The results obtained by these methods are compared and a good qualitative agreement is shown.

Calin Lazaroiu *(IBS-CGP Pohang & IFIN-HH Bucharest)*

Hessian symmetries of multifield cosmological models

Infinitesimal Noether symmetries of multifield cosmological models decompose into "obvious" and "hidden" (or "Hessian") symmetries, the latter of which exist only when the scalar manifold of the model is "globally of Hesse type". I develop the basic theory of such Riemannian manifolds and show that the only hyperbolic manifolds of this kind are the elementary hyperbolic space forms. This allows me to classify all multifield cosmological models with hyperbolic target which admit hidden Noether symmetries.

Mario Maican *(IMAR, Bucharest)*

Moduli of sheaves supported on curves of low genus contained in a quadric surface

We compute the Betti numbers of some moduli spaces of semistable sheaves supported on curves of genus 2, 3 or 4 that are contained in a smooth quadric surface **S**. The Euler characteristics of these moduli spaces (i.e. the alternating sum of the Betti numbers) are known to physicists as the genus zero Gopakumar-Vafa invariants of the total space of the canonical bundle of **S** (which is a Calabi-Yau threefold). Our technique is to relate the moduli spaces to certain flag Hilbert schemes whose Betti numbers are easy to compute, via the notion of alpha-semistability for coherent systems introduced by Le Potier. In our case, the parameter alpha is just a positive real number. A familiar wall-crossing phenomenon occurs when alpha transits through finitely many so called 'singular values'.

Yong-Geun Oh *(IBS-CGP, Pohang)*

Asymptotic behavior of Vianna's exotic Lagrangian tori

In this talk I will study various asymptotic behavior of Vianna's infinite family of monotone Lagrangian tori $\mathbf{T_{a,b,c}}$ in $\mathbf{CP^2}$ associated to Markov triples **(a,b,c)**. I will first prove that the Gromov capacity of the complement $\mathbf{CP^2 \setminus T_{a,b,c}}$ is greater than or equal to **1/3** of the area of the complex line

for all Markov triple **(a,b,c)**, and then explain construction of non-spreading family $\{\mathbf{T}_{a,b,c}\}$ whose loci completely miss a metric ball of nonzero size and in particular the loci of the union of the family is not dense in $\mathbf{CP}^2$. I will also discuss various open questions related to the symplectic topology of Vianna's tori. The talk is based on the joint work with Weonmo Lee and R. Vianna.

Liviu Ornea *(IMAR & University of Bucharest)*
The Kähler geometry of the Weinstein construction

We shall discuss the Weinstein construction of symplectic bundles in the framework of Kähler manifolds. We use it to obtain new examles of csc Kähler metrics which are not Einstein-Kähler, new examples of holomorphic harmonic morphisms with arbitrary dimension of the fibres, and new examples of balanced metrics. We finally use the Weinstein construction to give a local characterization of compact Kähler manifolds admitting holomorphic, totally geodesic and homothetic foliations. This a joint work with Paul-Andi Nagy.

Alexandra Iulia Otiman *(Universita' Roma Tre & IMAR Bucharest)*
Dolbeault cohomology of Oeljeklaus-Toma manifolds

Oeljeklaus-Toma (OT-) manifolds are a higher-dimensional generalization of Inoue-Bombieri surfaces and were introduced by **K**. Oeljeklaus and M. Toma in 2005. For any positive natural numbers ***s*** and ***t***, OT manifolds of type ***(s, t)*** are quotients of $\mathbf{H}^s \times \mathbb{C}^t$ by discrete groups of affine transformations arising from a number field **K** and a particular choice of a subgroup of units **U** of **K**. They are complex compact non-Kähler manifolds and a subclass is known to carry locally conformally Kähler metrics. In this talk we compute their Dolbeault cohomology by using the Leray-Serre spectral sequence and by relating their construction to certain domains contained in Cousin groups defined by lattices satisfying a strong dispersiveness condition. In particular, we obtain a new way of computing the Dolbeault cohomology of Inoue-Bombieri surfaces and we show that the Hodge decomposition holds for their de Rham cohomology. These results are joint work with Matei Toma.

Ovidiu Pasarescu *(IMAR, Bucharest)*
Infons and Energons, the two Faces of a String

In String Theory, a string is a tiny vibrating chord giving, as functions of its vibrations, all the elementary particles (and antiparticles). In order to give a specific elementary particle (as photon, or graviton) the string must vibrate (so it needs energy) in some way - amplitude, frequency,... (so it needs information). We arrive at seeing the string as a combination of two formal particles, already considered in the literature, namely the energon and the infon (in fact, inseparable, like the two faces of a coin). We consider here models of the infons, mathematically based on the Non-standard Analysis in Topoi (the notion of Topos has been initially introduced by A. Grothendieck in Algebraic Geometry). The non-standard extensions of a topos (the space where we consider that the infons live) have an intrinsic logic which is a conservative extension (as in the non-standard analysis of A. Robinson) of the intuitionistic logic (multi-valued, specific to topoi), as the logic of infons Gurevich and Neeman proved to be. We apply this model for some understanding of the human brain/mind (where the consciousness is intuitionistic, and the union between subconsciousness and consciousness is a conservative extension of consciousness). Both information and energy are related to the second Principle of Termodynamics, via Entropy. We add that this model is based on a kind of Quantum Physics based on truth values of propositions instead of probabilities, already considered in the literature.

Tudor Stefan Ratiu *(Shanghai Jiao Tong University)*
Group valued momentum maps

The space of smooth sections of a symplectic fiber bundle carries a natural symplectic structure. We provide a general framework to determine the momentum map for the action of the group of bundle automorphism on this space. Since, in general, this action does not admit a classical momentum map, we introduce the more general class of group-valued momentum maps which are inspired by the Poisson Lie setting. In this approach, the group-valued momentum map assigns to every section of the symplectic fiber bundle a principal circle-bundle. We study the properties of this group-valued momentum map. Also several examples will be given.

Ingo Runkel *(University of Hamburg)*
Surface defects in three-dimensional topological field theory

I would like to discuss a class of three-dimensional topological field theories called Reshetikhin-Turaev theories. Examples are Chern-Simons theories with compact gauge group. There are no point-like observables in these theories, and one typically considers line-observables, called Wilson lines. However, one can also discuss observables associated to surfaces. We will see how to describe such observables in Reshetikhin-Turaev TQFTs and look at some applications.

Carlos Shahbazi *(University of Hamburg)*
The symplectic duality structure of four-dimensional supergravity

I will give a pedagogical introduction to the mathematically rigorous global geometric formulation of the generic bosonic sector of four-dimensional ungauged supergravity on an oriented four-manifold of arbitrary topology **M**, paying special attention to its symplectic duality structure and Dirac quantization. This global geometric formulation, called geometric supergravity, is based on a choice of Lorentzian submersion over **M**, which determines the section sigma model of the theory, and a choice of flat symplectic vector bundle equipped with a complex positive polarization, which determines the gauge sector of the theory. I will show how a complex polarization is locally equivalent to a choice of period matrix, obtaining, as a result, a generalization of the master formula of Gaillard and Zumino to homogeneous manifolds with non-trivial principal bundle structure. Furthermore, I will implement Dirac quantization in terms of a certain locally constant sheaf of symplectic lattices, a construction that yields the global geometric description of the gauge sector of the theory in terms of an associated bundle of polarized abelian varieties. Furthermore, I will identify the global electromagnetic U-duality group of the theory as the group of automorphisms of a scalar-electromagnetic structure, which we characterize in terms of a certain short exact sequence. As a corollary to our work, we obtain a symplectic extension of standard electrodynamics which seems to be new in the literature. (Work in collaboration with Calin Lazaroiu.)

Rafal R. Suszek *(University of Warsaw)*
Geometrisation in supersymmetry-invariant cohomology – supergerbes, κ-symmetry, İnönü-Wigner contractions and all that

Geometrisation of de Rham cocycles (with integer periods) in the form of so-called abelian gerbes has long been known as not only necessary for a rigorous definition of the lagrangean (σ-model) dynamics of charged pointlike particles, strings and branes and its geometric (pre-)quantisation but also exceptionally useful in the canonical description of its symmetries and dualities, classification and field-theoretic realisation of the corresponding defects, as well as in a cohomological description of obstructions against their gauging and classification of the ensuing gauged σ-models. In the talk, a natural geometrisation scheme for cocycles in the supersymmetry-invariant refinement of the de Rham cohomology on (a class of) homogeneous spaces of supersymmetry Lie supergroups

shall be postulated, in close structural analogy with its Graßmann-even ancestor, and illustrated on examples motivated by superstring-theoretic considerations. The geometrisation, based on the classical correspondence between the Cartan-Eilenberg cohomology of the supersymmetry Lie supergroup and the Chevalley-Eilenberg cohomology of its tangent Lie superalgebra, in conjunction with the cohomological description of (equivalence classes of) Lie-superalgebra extensions and a moment-map criterion for their integrability, gives rise to higher-(super)geometric objects termed supergerbes. Various (anticipated) equivariance properties of the supergerbes shall be indicated, including the physically fundamental κ-symmetry, and – time permitting – a higher-geometric variant of the İnönü-Wigner contraction mechanism (for the supersymmetry Lie superalgebras) shall be outlined.

Adrian Tanasa *(University Bordeaux & IFIN-HH Bucharest)*

Tensor models and the Sachdev-Ye-Kitaev model

Tensor models represent a natural generalization of the celebrated matrix models. These matrix models are known to be connected to various domains of mathematics and theoretical physics. One of the main results of the study of matrix models is that their perturbative series can be reorganized in powers of **1/N** (**N** being the matrix size). In the first part of this talk I will present such a **1/N** expansion for some tensor models. In the second part of the talk, I will show how tensor models are related to the celebrated AdS/CFT Sachdev-Ye-Kitaev (SYK) model. Finally, I will present some further results I have recently obtained when comparing the perturbative series of tensor models and of the SYK model.